or even years, on board a ship, for men not well trained to such existence, except where the composition of the staff is made with a sharp eye for compatibility and incompatibility of character. Especially the scientific leader must be a man of imposing personality rather than of special scientific competence, for it will fall to his share to dictate in every case where conflicting tendencies threaten to do away with social harmony.

But though all this may be considered to offer considerable difficulties in the way of execution, nevertheless the future for oceanography will belong to such floating biological stations, and the time is perhaps not so far distant, when more than one of them will cross the oceans, and supersede completely the now adopted system of single-handed expeditions of young naturalists. The necessity for such expeditions is doubtless existing, in so far as it is better to try the solution of problems regarding the tropics by travelling alone than by staying at home. And no doubt very many geographical, ethnographical, geological problems have been greatly advanced by competent travellers, and will furthermore be advanced in the same way. Collections of animals and plants have been made, mostly terrestrial, and the systematic part of biology has had its due share. But all more complicated studies, such as require more technical appliances and preparations, remain in the background, for the same reason which has forced us already in Europe to establish well-organised morphological, physiological and chemical laboratories, both inland and on the sea-shore. And if we cannot go on without them in Europe, where the general conditions for biological research are so much more advantageous, we must certainly have them, if we wish to advance our knowledge of tropical, terrestrial and marine organisms.

Botany enjoys already some advantages through the botanical gardens in Ceylon and Java, and it is to be hoped that the British and the Dutch authorities will use their exceptional opportunities in both places to establish some sort of regulations for their use by the botanists of all nations. May it not be possible to enlarge these botanical gardens by adding also some facilities for research of animal morphology? The Zoological Station at Naples has a special part prepared and equipped for morphological and physiological botany; in the first place, of course, for marine algæ, but any other sort of botanical study, for which Naples offers opportunities, might be undertaken there, and already a valuable work on the cultivation of figs has been greatly assisted by the Zoological Station. No doubt every naturalist who travels in Ceylon or the Sunda Archipelago receives the most valuable advice and assistance by Messrs. Trimen and Treub, and perhaps these most competent gentlemen would be the first to advocate a larger endowment of their establishments in the sense just now indicated; science and research would be certainly greatly benefited by it.

All these dreams and perspectives are opened up before us when we are looking over the enormous mass of new facts and new material for study brought together by the *Challenger*. And to think that there were only four naturalists and one chemist on board all the years long, and one of the naturalists died during the expedition! It is, I think, only right to remember here that two others of the gentlemen of the civilian staff so heavily overtaxed their strength with the often surely very monotonous, and always very hard work, that their health broke down soon after their return, and they fell victims to their enthusiasm. If it is only right to pay the highest possible respect to Mr. Murray for his extraordinary power of work, talent for administration and competence in dealing with the special problems of deep-sea deposits, and if we gladly recognise the excellent work done by Mr. Buchanan, I think nobody will be so ready as these two gentlemen to join here in thankful remembrance of the share of work that fell to their late companions, Sir Wyville Thomson, Prof. Moseley, and Dr. von Willemöes-Suhm. And may it be once more permitted to the writer of these lines, who by right or wrong claims some special title for it as a sort of international official of biological science, to utter the thanks of science to the officers and men of the *Challenger*, and to the Admiralty, and to the British Government and Parliament, and to the whole British nation for having set the example to the world of one of the grandest and most successful scientific expeditions that ever has been, and most likely for considerable time to come will be, started.

ANTON DOHRN.

OUR BOOK SHELF.

Horses, Asses, Zebras, Mules, and Mule Breeding. By W. B. Tegetmeier, F.Z.S., and C. L. Sutherland, F.Z.S. (London: Horace Cox, 1895.)

THE first portion of the title of this interesting work is somewhat misleading, for with the exception of some half-dozen pages which deal mainly with the distinctions between the horse and the other species of the genus, and a description of the supposed new species known as Prejevalsky's Horse, the book entirely relates to asses, zebras, and mules. None of the varieties of the horse which have been produced during the period of its long domestication are referred to. We mention this fact in case the general reader should infer from the title of the work that it was a treatise on the multitudinous domestic varieties of the horse which exist in nearly every quarter of the globe.

The volume is conveniently divided into two parts. Part i. is chiefly of zoological interest, and contains very complete and accurate descriptions of the existing species of the genus known to modern zoologists under the name of Equus, including, in addition to Prejevalsky's Horse, an account of the still more recently discovered Grevy's Zebra. The engravings which illustrate the letterpress are particularly good, and will greatly assist the student in his endeavour to master the peculiarities of each species. It concludes with a chapter on the hybrids which may be produced by crossing the horse with the other species of the genus Equus.

Attention should be directed to an assertion on the part of the authors that a remarkable and noticeable difference exists in the period of gestation of the mare and ass. The duration of gestation in the mare is well known to be eleven months, and it has generally been assumed that it was similar in the ass and zebra. The authors, however, emphatically assert that in asses and zebras it usually exceeds twelve months; one of them, Mr. Sutherland, who is well known as an extensive breeder of mules, quotes from his stud-book eight instances of the period of gestation in the ass, the result in six cases of a single service, the period varying from 358 to 385 days. It seems strange that such a marked difference should have hitherto escaped mention in all previously published works.

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Part ii. is devoted exclusively to mules and mule breeding, and is replete with valuable and exhaustive information on these subjects. The authors strenuously deny the existence of fertility in either the male or female mule, affirming that abnormal lactation not unfrequently occurs in female mules, when milk is secreted in great abundance, and that the foals which they are observed to be suckling are in reality the foals of other animals which the mules have adopted. With regard to the oft-quoted instance of a mule in the Acclimitisation Gardens in Paris, which has produced foals when mated both with the horse and ass, the writers doubt whether the animal is a mule, and assume that she is an ordinary mare, whose female parent was influenced by a first alliance, as is so often the case in dogs and other animals. If their contention is correct, the mule may still aptly be described as "an animal of no ancestry and with no hope of posterity."

The writers are enthusiastic, nay even fulsome in their praise of this hybrid, and bitterly lament the lack of appreciation in which it is held in Great Britain as compared with America and some European States. "In endurance," say the authors, "capability of hard labour, economy in keep, longevity, and freedom from disease, mules far surpass horses." Into so controversial a matter this is not the place to enter, and we must content ourselves with the belief that so plain and oftentimes so ugly an animal as the mule will never supplant to any great extent, in this country at least, the beautiful and graceful varieties of the horse of which Englishmen are naturally so proud.

To any of our readers who are interested in the subject of mule breeding, this work may be heartily recommended; and, in conclusion, we feel bound to compliment in the highest terms all who have been instrumental in its production.

W. F. G.

The Moon. By T. Gwyn Elger, F.R.A.S. Pp. 174. (London: George Philip and Son, 1895.)

In this latest work on the moon, from the pen of one of the foremost of British selenographers, the most noteworthy feature is the excellent chart, eighteen inches in diameter; this is given in four quadrants, but it can also be obtained complete and separately. All the named formations are distinctly shown, and the names of the more important are very clearly printed on the map itself. The greater part of the text resolves itself into a descriptive index to the map; but though this appears in rather stereotyped fashion, it embodies a good deal of information which has been gleaned by the author during many years of observation. An introduction of forty pages deals with lunar phenomena generally, and includes numerous hints which will be of use to the observer. Mr. Elger objects most emphatically to our satellite being spoken of as a changeless world, and justifies his position by stating that volcanic outbursts, producing mountains as large as the Monte Nuovo, might occur in many parts of the moon without the world being any the wiser. Though possessing little of novelty, and not appealing to the general reader, the book and map together constitute a handy work of reference which observers of experience, as well as beginners, will be glad to have by them. A few details as to the phenomena to be observed during eclipses of the moon, might have been included with advantage.

Algebra. Part i. By M. H. Senior. (Oldham: D. W. Bardsley.)

Kindergarten methods of teaching are now applied to most subjects. In this small book of fifty pages, the author endeavours to make algebra interesting to young students by associating the abstract symbols with concrete objects. The novel features of the book are the explanation of brackets, the exercises on factors, short methods of multiplication and division, the elucidation of signs, and the numerous practical examples.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Argon and Dissociation.

The discovery of the new substance argon, by Lord Rayleigh, has given rise to a difficulty which, it is thought by some, shows that the periodic law of Mendelejeff has not that generality which has been attached to it by chemists during the last few years.

According to Lord Rayleigh's determination, the density of argon is 19·9 (H = 1), making the atomic weight 39·8, as the molecules are shown to have no internal energy of the same order as their energy of translation, and hence to be monatomic. Argon with this atomic weight cannot possibly find a place in the natural classification. If its atomic weight were less than 39·1 (the atomic weight of potassium), argon would fall in the VIIIth or interperiodic group in Lothar Meyer's table; and its properties, so far as they have been investigated, would harmonise with this position.

The determination of the vapour density of iodine by V. Meyer, Crafts and Meier, and others, has shown that at temperatures below 1000° C. the gas consists of diatomic molecules, while above this dissociation takes place, and above 1500° C. we have the dissociation complete, and the molecules are monatomic.

Why, then, cannot we have a similar behaviour in the case of argon?

If argon at low temperatures (somewhere near its critical point) consisted of diatomic molecules, which dissociate as the temperature rises, the difficulty of the position of argon would be removed. Thus, suppose at the temperature at which 19·9 was determined as the density of argon, the dissociation has proceeded so far that 5 per cent. of the molecules remain diatomic; the average molecular weight would be 39·8, but we should have two kinds of molecules, monatomic and diatomic, and the atomic weight under these supposed conditions would be

$$\frac{39\cdot8 \times 100}{105} = 37\cdot9.$$

The ratio of the specific heats, at constant pressure and constant volume, taking 1·4 for this ratio for a gas with diatomic molecules, and $\frac{5}{3}$ for a gas with monatomic molecules, would be for argon, on the above supposition,

$$\frac{95 \times \frac{5}{3} + 5 \times 1\cdot4}{100} = 1\cdot65.$$

This value agrees very well with the values (1-16—1-65) determined for argon.

This explanation reconciles argon with the natural classification; and as yet no facts have been published in opposition to it.

If this hypothesis be true it could be easily verified, for at temperatures, not much higher than that at which the vapour density determinations were made, the dissociation would be complete; and hence the vapour density in agreement with a molecular weight about 38; and also at lower temperatures than that at which the vapour density has been determined the gas would not obey Charles' law; for the recombination of the single atoms to form diatomic molecules, and possibly molecules containing a greater number of atoms, would cause a contraction greater than that due merely to the cooling of the gas according to the ordinary law.

Penry Vaughan Bevan.

Melbourne University, April 18.

Prof. Bevan ascribes to me work done conjointly with Prof. Ramsay. An addendum to our paper (see *Proc. Roy. Soc.*) contains our account of experiments by Prof. Ramsay, especially directed to examine the question raised.

It has turned out that the gas possesses the same value of $\frac{pv}{T}$ as hydrogen, and that the value of this expression is not altered between − 90° and + 250°. The most trustworthy determination of the ratio of specific heats gives the number 1·65; but much dependence is not to be placed on the accurate value

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